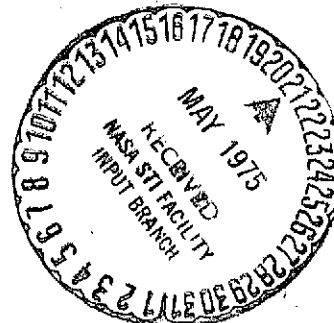


SOME PECULIARITIES OF INTRACARDIAC AND INTRACEREBRAL HEMOCIRCULATION IN PATIENTS SUFFERING FROM RHEUMATOID ARTHRITIS

I. Ye. Oranskiy and L. A. Kozlova

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| 16. Abstract The indices of intracardiac and intracerebral hemodynamics and the rhythm of their diurnal changes were studied in 225 patients suffering from rheumatoid arthritis. Grave disorders were shown in the systemic and regional blood circulation and intracardiac hemodynamics, caused by a general pathological process. The relation between frequency of change in the cerebral hemocirculation and condition of the cardiovascular system on the whole was noted. | | | | | |
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SOME PECULIARITIES OF INTRACARDIAC AND INTRACRANIAL HEMOCIRCULATION IN PATIENTS SUFFERING FROM RHEUMATOID ARTHRITIS

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In rheumatoid arthritis, in connection with the prolonged /47* course of the process in the connective tissue, deconditioning of the patients and the reduction in muscle tonus accompanying it, which plays a large part in systemic blood circulation, changes in the myocardium are quite frequently observed, which lead to disruption of the contractile function of the heart [7, 10, 12, 14]. These changes, which are reflected in the indices during clinical-instrumental studies, indicate generality of the process, involving many systems of the body [1-5, 8, 9, 11, 13, Khan and Spodick].

Simultaneously with disruption of the contractile function of the heart, afflictions of the vascular system are found, caused by vasculitis, which lead to changes in the regional blood circulation in the lungs, kidneys and other organs. In rheumatoid arthritis, the possibility of affliction of the vascular system of the /48 brain is not excluded. In this respect, there is great interest in study of the intracranial hemocirculation, for the purpose of revealing the earliest disruptions of it in a given form of pathology.

Considering the close connection of the cranial and systemic blood circulation and the large part of the contractile function of the heart in formation of hemodynamic shifts, we carried out a study of the intracranial and intracardiac hemodynamics and an analysis of the intersystem correlative connections in rheumatoid arthritis patients.

* Numbers in the margin indicate pagination in the foreign text.

METHODS

The study was carried out in 225 rheumatoid arthritis patients, predominately with the joint form. The ages of the patients varied from 18 to 42 years. The duration of the disease was 3-10 years, for the majority of patients. The leading complaint was pains in the joints, of varying intensities and duration, and constraint in the mornings, limiting movement in the joints. Hypotrophy of the muscles of the upper and lower extremities, mainly in the distal sections, and deformation of the joints, owing to exudative and proliferative changes in the periarticular tissues, were noted in a considerable number of the patients (78%). X-ray changes (osteoporosis, constriction of the joint clefts, ... wasting away of the bone and tissue of the joint surfaces and single ankyloses) were found in 89% of the patients. Taking the clinical and laboratory indices into account, degree I was established in 165 patients, degree II activity in 51 patients, and signs of activity of the process were not found in 11 patients.

For the purpose of study of the contractile function of the heart, and of the intracardiac and intracranial hemodynamics, EKG, BKG, a kinetocardiogram from the zones of the left and right ventricles of the heart, a transverse rheogram of the body (rheocardiogram), for deciding on the relative changes in the stroke volume of the heart, and REG of the frontal-mastoid lead were recorded.

Considering the dependence of the functional state of the cardiovascular system on the time factor (circadian rhythms), day-long studies of 60 patients were carried out, every 4 hours, beginning at 8 a.m.

Beside the quantitative parameters, the correlative connections of the combined indices of the cranial and systemic blood circulation were studied. The material was processed in a M20 digital computer.

RESULTS

In primary examination of the patients, muffling of the heart sounds (of 65%), a soft systolic murmur at the apex of the heart (of 48%) and tachycardia (of 15%) were found quite often. 15 patients had complaints of moderate headaches, disturbance of sleep and irritability.

Shifts characteristic of diffuse changes in the myocardium ^{/49} were noted electrocardiographically in 17% of the patients, blockade of the right branches of the bundle of His in 1% and signs of coronary insufficiency in 3 patients. Analysis of the BKG, with evaluation by the Braun scale, revealed II and III degree changes in 45% of the patients.

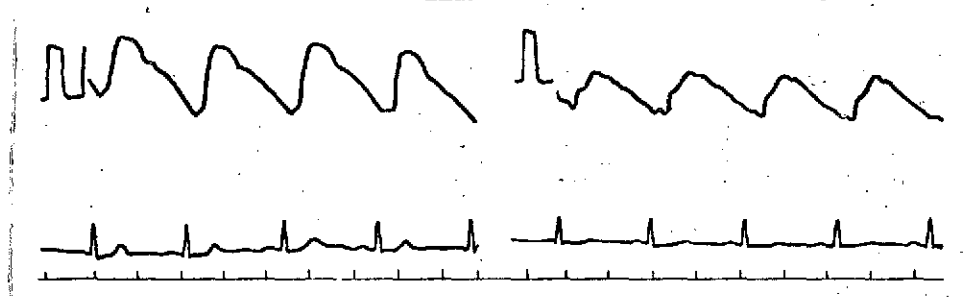
The following attracted attention in the initial kinetocardiograms: lengthening of the asynchronous contraction phase of the left ventricle to 0.069 ± 0.001 sec, of the right, to 0.078 ± 0.001 sec, and increase relative to the normal values of the isometric contraction phase and, as a rule, a normal ejection period. The index of stress of the myocardium had a tendency toward some increase. The Q-II sound interval was shorter than the Q-T_{EKG} interval by 0.03 sec ($P < 0.02$).

The diurnal changes in the cardiodynamics (Table 1) disclosed a tendency toward quickening of the rhythm in the 4-8 p.m. interval, and relative bradycardia was noted at midnight. The maximum values of the asynchronous contraction phase were found at 8 a.m. and midnight, and the minimum ones, in the daytime. The isometric contraction phase reached maximum values at 4 p.m. ($P < 0.05$) and the ejection period, at midnight ($P < 0.02$).

The amplitude of the rheocardiograms of rheumatoid arthritis patients were significantly lower than the indices of healthy people during the entire study period; its minimum values occurred at 4 p.m. ($P < 0.05$) and the maximum ones in the morning hours.

TABLE 1. RHYTHM OF DIURNAL CHANGES IN CARDIO- AND HEMO-DYNAMICS INDICES OF RHEUMATOID ARTHRITIS PATIENTS ($M \pm m$)

| Index | Time of day | | | | | |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | 8 AM | 12 noon | 4 PM | 8 PM | midnight | 8 AM |
| C (hundredths of sec) | 7.1 ± 6.0 | 92.1 ± 5.0 | 87.5 ± 5.0 | 94.5 ± 6.0 | 102.2 ± 5.0 | 98.7 ± 4.0 |
| Asynchronous contraction phase (in sec) | 6.9 ± 0.3 | 6.6 ± 0.3 | 6.8 ± 0.3 | 6.9 ± 0.2 | 7.1 ± 0.1 | 7.3 ± 0.2 |
| Isometric contraction phase (in sec) | 4.9 ± 0.3 | 5.4 ± 0.1 | 4.0 ± 0.1 | 4.9 ± 0.3 | 5.2 ± 0.2 | 5.1 ± 0.3 |
| Ejection phase (in sec) | 29.6 ± 0.4 | 28.0 ± 0.4 | 26.8 ± 0.6 | 28.1 ± 0.8 | 31.1 ± 0.69 | 30.8 ± 0.8 |
| Pressure (mm Hg): | | | | | | |
| Systolic | 108 ± 1.5 | 105 ± 3 | 102 ± 2.5 | 101 ± 3 | 106 ± 2 | 107 ± 1 |
| Diastolic | 72 ± 1.5 | 70 ± 2 | 68 ± 1.5 | 66 ± 1.5 | 70 ± 1.5 | 71 ± 1 |
| ARKG (in rheographic units) | 0.72 ± 0.07 | 0.76 ± 0.05 | 0.66 ± 0.04 | 0.83 ± 0.03 | 0.71 ± 0.03 | 0.72 ± 0.05 |



REG in the frontal-mastoid lead of rheumatoid arthritis patients: upper curve, normal REG (group 1); lower curve, low-amplitude REG changed in shape (group 2).

The rheoencephalographic curves of 72% of the patients (group 1) were normal in shape, amplitude and time parameters, with a steep anacrotic rise, rapid descent and expressed incisure. The REG of 28% (group 2) had a humped or arcuate shape, with supplementary spikes in the anacrot (see Figure) and significant differences in all indices, compared with group 1 (Table 2). The daily variations in REG amplitude of group 1 were similar to the rhythm of healthy people. Its maximum values were noted at 4 and 8 p.m. and the minimum ones at 8 a.m. and midnight. The shift in amplitude of the variations was noted in group 2 patients and, at 4 p.m.,

the sign of the trend of the daily curve (Table 3), which was monotonic, changed, with small rises at noon and 8 p.m. and a decrease at midnight.

TABLE 2. REG INDICES OF RHEUMATOID ARTHRITIS PATIENTS ($M \pm m$)

| Index | Normal REG (group 1) | | Pathological REG (group 2) | |
|--------------------------|-------------------------|------------------|-------------------------------|------------------|
| | left hemisphere | right hemisphere | left hemisphere | right hemisphere |
| REG (in %) | 72 ± 2 | | 28 ± 5 | |
| normal shape | | | | |
| humped shape | | | | |
| A_{REG} in rel units | 0.83 ± 0.01 | 0.82 ± 0.02 | 0.55 ± 0.03 | 0.65 ± 0.01 |
| $A_{incisure REG}$ | 0.27 ± 0.01 | 0.28 ± 0.01 | 0.50 ± 0.02 | 0.58 ± 0.02 |
| α (in sec) | 0.32 ± 0.03 | 0.31 ± 0.02 | 0.92 ± 0.04 | 0.89 ± 0.03 |
| Q-X interval | 0.10 ± 0.001 | 0.09 ± 0.001 | 0.28 ± 0.001 | 0.26 ± 0.001 |
| AR_{KG} (in rel units) | 0.14 ± 0.002 | 0.16 ± 0.002 | 0.18 ± 0.003 | 0.18 ± 0.002 |
| | 1.61 ± 0.004 | | 1.31 ± 0.005 | |

TABLE 3. RHYTHM OF DIURNAL CHANGES IN REG INDICES OF RHEUMATOID ARTHRITIS PATIENTS ($M \pm m$)

| Index | | Time of day | | | | | |
|---|--|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | | 8 AM | | 12 noon | | 4 PM | |
| | | group 1 | group 2 | group 1 | group 2 | group 1 | group 2 |
| A_{REG} (relative units) | | 0.83 ± 0.01 | 0.55 ± 0.03 | 0.94 ± 0.03 | 0.70 ± 0.02 | 1.02 ± 0.03 | 0.73 ± 0.02 |
| Hemisphere asymmetry | | - | + | - | + | + | - |
| $A_{REG} - A_{RKG}$ correlation coefficient | | +0.40 | +0.80 | +0.73 | +0.78 | +0.50 | +0.80 |
| continued | | | | | | | |
| Index | | Time of day | | | | | |
| | | 8 PM | | midnight | | 8 AM | |
| | | group 1 | group 2 | group 1 | group 2 | group 1 | group 2 |
| A_{REG} (relative units) | | 1.0 ± 0.02 | 0.70 ± 0.03 | 0.87 ± 0.04 | 0.60 ± 0.02 | 0.80 ± 0.04 | 0.56 ± 0.03 |
| Hemisphere asymmetry | | + | - | + | + | - | + |
| $A_{REG} - A_{RKG}$ correlation coefficient | | +0.80 | +0.60 | +0.30 | +0.83 | +0.20 | +0.62 |

We did not find significant differences in the clinical picture of the disease in patients of these groups. However, changes in the REG were observed most often in patients with disruption of the contractile function of the heart ($\chi^2 = -4.8$).

DISCUSSION OF RESULTS

It is known from data in the literature [1, 2, 6, 10] that the contractile function of the left ventricles of rheumatoid arthritis patients is reduced. This is explained by affliction of the myocardial fibers and a decrease in their contractility, as the result of a prolonged, chronic process, involving the joints and, frequently, internal organs.

Actually, as ballistocardiographic studies and data of the time parameters of chronocardiograms show, the strength of the cardiac contraction in the isometric contraction phase of 30-45% of the rheumatoid arthritis patients is reduced, and the time expended in raising the pressure in the ventricles of the heart considerably exceeds normal values. At the same time, the myocardium, to judge by the ejection period, has a sufficient reserve capability to sustain the necessary pressure level in the cavities of the ventricles. On the basis of what has been stated, it can also be assumed that changes in the cardiac kinematics in rheumatoid arthritis are caused by two factors: dystrophy of the myocardium (characteristic EKG changes, increase in length of the asynchronous contraction phase), and a decrease in venous return, leading to underfilling of the ventricles. The decrease in RKG amplitude, closely correlated with the stroke volume of the heart, and tonus of the ~~skeletal musculature, leading, as a rule,~~ to a decrease in the venous inflow to the heart, are confirmation of what has been said. /51

Consequently, an increase in the isometric contraction phase of the left ventricle should be considered as a symptom of functional hypodynamia, caused by under filling of the ventricle in diastole and by a decrease in the contractile function of the myocardium.

An increase in the isometric contraction phase of the right ventricle, with normal ejection period indices, apparently reflects compensatory hypodynamia, directed toward synchronization of the overall activity of the heart. The latter suggestion is competent, because the pressure level in the pulmonary artery, calculated by a Burstin nomogram (duration of relaxation of the right ventricle, with the pulse rate taken into consideration), was normal in all observations (24-27 mm).

Analyzing the length of the electrical and acoustical systole, the possibility also cannot be excluded of the presence of the Heglin syndrome in rheumatoid arthritis patients. It indicates an energetically dynamic insufficiency of the heart.

Together with this, it should be noted that the functional hypodynamia syndrome of the heart in rheumatoid arthritis patients is unstable, and that it is observed only in the state of rest, when the load on the myocardium is low. With increase in patient activity, a change in cardiac activity to a new mode of operation is observed, to a true hypodynamia mode. It appears most clearly at noon and midnight. It can be assumed that the cardiac activity of rheumatoid arthritis patients occurs over the extent of the day, within the upper limits of compensation, providing the needs of the body, during a decrease in its physical activity. This kind of change in cardiac activity is found most often in cases of a very long course of the disease, frequent aggravation of the process and decrease in tonus of the skeletal musculature and, sometimes, in the acute stage of the disease.

The state of the cranial hemocirculation of rheumatoid arthritis patients deserves special attention. The irregularity found in the rheographic indices leads to the proposal that, in one-third of the cases, more often in those where there are disruptions of the cardiovascular system, the cerebral vessels are involved in the

overall pathological process. These changes lead to disruption of their elastic properties, to an increase in tonus and a decrease in pulse blood filling. Since the stroke volume of these patients is decreased, adequate provision of the cranial blood flow at 4 and 8 p.m. apparently is accomplished, predominately by regional regulation. The low correlation coefficients of the REG amplitude and stroke volume at these hours of the day are evidence of this.

It also is of interest to note that the level of pulse blood filling of the brains of patients with normal and changed hemocirculation is different. Its greatest index is noted at 4 p.m. and the least, at 8 a.m. and midnight. A distinct hemisphere asymmetry, with predominance in the left hemisphere, was observed at these hours.

Everything set forth leads to the proposal that the vessels of the brain are afflicted in a part of the cases of rheumatoid arthritis. Their affliction is most likely in patients with disturbances of the cardiovascular system as a whole. Shifts in the diurnal periodics in the function of this system also indicate serious disturbances of regulation of systemic and regional blood circulation.

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